

U. S. D E P A R T M E N T O F E N E R G Y

FOSSIL ENERGY STRATEGIC PLAN

MEETING
21st CENTURY
CHALLENGES

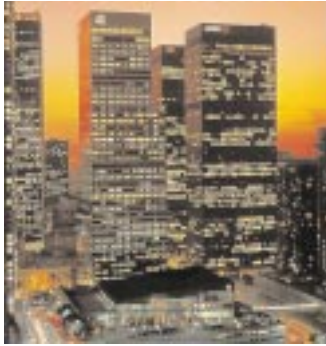
A SUPPLEMENT TO THE U.S. DEPARTMENT OF ENERGY STRATEGIC PLAN OF SEPTEMBER 1997



Office of the
Assistant Secretary for Fossil Energy
U.S. Department of Energy

MARCH 1998

Introduction



The availability of affordable energy will be essential to our nation's economic strength in the coming decades, and major energy forecasts agree that fossil fuels will be the dominant energy source for the foreseeable future. While Americans want to continue to enjoy the economic benefits of lower-cost energy, they also want reliable energy supplies that do not harm the environment. Advances in fossil fuel technology coupled with the continued readiness of the Strategic Petroleum Reserve, our emergency oil stockpile, are key to accomplishing this.

The Department of Energy (DOE), in partnership with the private sector, supports the development of economically viable and environmentally compliant technologies that would otherwise emerge far more slowly, if at all. This support focuses on areas where there are large potential public sector

Our mission is to enhance U.S. economic and energy security by: (1) managing and performing energy-related research that promotes the efficient and environmentally sound production and use of fossil fuels; (2) partnering with industry and others to advance clean and efficient fossil energy technologies toward commercialization in U.S. and international markets; (3) managing the Strategic Petroleum Reserve to reduce vulnerability to economic, national security, and foreign policy consequences of supply interruptions, and; (4) supporting the development of information and policy options that benefit the public by ensuring access to adequate supplies of affordable and clean energy.

benefits, but rewards, given the risks, are not adequate to attract high levels of private sector investment. The Federal research, development and demonstration (RD&D) portfolio has evolved in response to a number of strategic drivers, and includes activities in the areas of power generation from natural gas, coal, renewable sources, nuclear fission and fusion; liquid and gaseous fuels from conventional and alternative sources; and end-use efficiency.

DOE-supported RD&D has already returned substantial benefits to consumers and taxpayers. These returns include

cleaner air, lower energy costs, reduced risks of energy supply disruption, and improvements to our balance of trade. The potential for future returns is even greater as technologies that are nearly through the RD&D pipeline enter the marketplace. These returns will extend far beyond U.S. borders. Energy to

fuel continued global growth will come primarily from fossil fuels, particularly in rapidly-developing nations such as China and India that are rich in coal reserves. Exporting cleaner, more efficient energy technologies will not only benefit the U.S. economy, but will help satisfy growing global energy demand and improve living standards, while controlling greenhouse gas emissions and preventing pollution.

This strategic plan evaluates the key challenges facing our nation -- a nation whose economic strength relies on fossil fuels. It describes the strategies being pursued by DOE's Office of Fossil Energy in the areas of coal and gas power systems, coal-derived fuels, natural gas and petroleum recovery and processing, and the Strategic Petroleum Reserve. More detailed information on programs and objectives can be found at the Office of Fossil Energy Internet Web Site at www.fe.doe.gov.

This plan does not include the production activities carried out under the Fossil Energy Naval Petroleum and Oil Shale Reserves Program. The Department, as required by Congress, concluded in February of 1998 sale of the main asset of this program, the Elk Hills oil field, and is investigating options for disposition of the remaining assets.

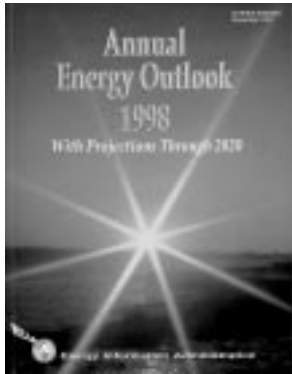
Our vision is that the Fossil Energy program contributes to a more secure energy future, to greater U.S. economic prosperity and to an improved quality of life.

- By 2000, life expectancy of critical Strategic Petroleum Reserve drawdown systems is extended by 25 years, and maximum readiness is achieved for its substantial crude oil inventory.
- By 2010, our success in managing research and development has enhanced U.S. leadership in the development, application, and export of affordable and environmentally sound energy technologies.
- In the longer term, our pacesetting research has identified entirely new concepts of fossil energy technologies that significantly reduce greenhouse gas emissions, contribute to the Nation's energy security, and ensure the availability of affordable fossil fuels into the middle of the 21st century and beyond.

The technical, analytical, and managerial capabilities of our workforce are considered world class. Our operations adhere to the highest environment, safety, and health standards in the protection of our workers, the public and the environment.

Energy Outlook And Strategic Issues

Energy Outlook



The Reference Case in the Energy Information Administration (EIA) 1998 *Annual Energy Outlook* represents a consumer-friendly scenario where energy prices in the year 2020 are largely unchanged from today's, and in some cases lower. It does not assume any incentives to reduce carbon emissions, and reflects an optimistic view of U.S. natural gas and world oil supplies, which is currently shared by a number of other major forecasters. It is in sharp contrast to projections several years ago when, for example, year 2010 projected prices for world oil and lower-48 wellhead natural gas were 88% and 136% higher, respectively, in EIA's 1992 *Annual Energy Outlook* than in the 1998 Outlook.

Projected low prices strongly impact EIA forecasts of supply and demand. As shown in *Figure 1*, EIA's projected market share for most fuels changes little through 2020. The fossil fuel share of the domestic energy market increases from 85% in 1995 to 90% in 2020. With total energy consumption increasing by over 30% during this period, energy-related CO₂ emissions, the most

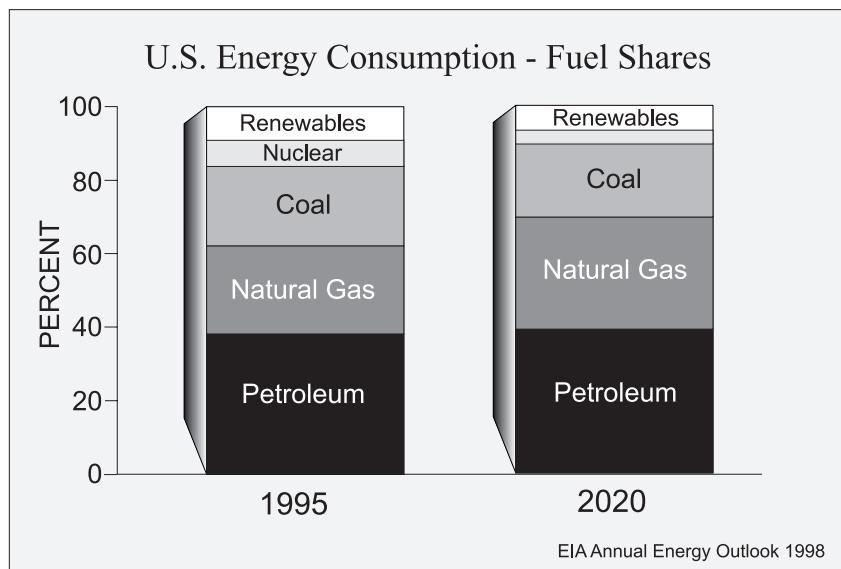


Figure 1

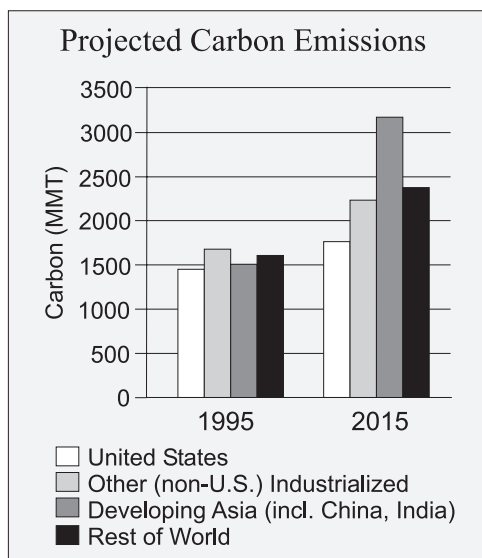
pervasive greenhouse gas, increase nearly 39%. Low oil prices lead to steadily increasing consumption in the U.S. and worldwide. Low natural gas prices through 2020 result in gas becoming the fuel of choice for electricity generation, delaying significant penetration by renewable and advanced coal technologies. While no new nuclear electricity generation is assumed, nuclear capacity does not decline significantly until after 2010.

EIA's 1997 *International Energy Outlook* shows world energy consumption rising faster than in the United States due to higher population growth and the rapidly expanding economies of developing countries. Global energy consumption is expected to grow by 54% between 1995 and 2015, with countries outside of the industrialized world accounting for nearly 70% of the growth. The largest expansion in energy use during the same period occurs in the developing countries of Asia, where energy demand increases by 129%, led by the economies of China and India. World energy-related carbon emissions are forecast to increase by over 55% by 2015.

Key Issues and Uncertainties

EIA and most other forecasts assume a business-as-usual environment where there are no major policy shifts, no new energy-related legislation, and no crisis to significantly alter the status quo. Many believe that this is not the only scenario that should be considered when determining national energy policy and R&D priorities, since there are a host of factors that could put energy trends on a very different track. Issues and uncertainties that could have far-reaching effects on domestic energy use are outlined below.

Figure 2



Climate change may prove to be the most important strategic driver. An agreement was reached (which will require Senate ratification) at the December 1997 meeting in Kyoto, Japan, to reduce average U.S. carbon emissions over the 2008 to 2012 period by an amount that is about 30% below currently projected emissions. For the U.S. to comply, ongoing modeling and analysis indicates that maximum efficiency gains in all energy consuming sectors will not be enough. Significant carbon reductions will still be needed, especially in the transportation and electric generation sectors. Projected carbon emissions (*Figure 2*), based on EIA's 1997 *International Energy Outlook* (IEO97) suggest that it will be even more of a challenge to limit greenhouse gas emissions on a worldwide basis without adversely

impacting the economies of rapidly developing countries such as India and China.

Oil security remains a prominent issue despite the relative tranquility in the market in recent years. Our economy is almost totally dependent on oil for its transportation needs. By 2015, it is projected that: 1) demand for petroleum in non-industrialized countries will nearly double; 2) the U.S. will be importing more than 60% of its oil; and 3) the Middle East will control nearly 70% of the world petroleum export market. This concentration of export market control will be greater than what existed in the 1970's and early 1980's when supply disruptions caused severe economic dislocations and fundamentally reordered U.S. and IEA member nations' energy security program priorities.

China, India Demand Could Add to Global Competition for Crude Oil

EIA projects that China and India could be consuming 11.9 million barrels per day of oil in the year 2015. As the October 30, 1995, issue of *Fortune Magazine* reported, however, if the per capita energy consumption of China and India rises to that of South Korea, and the Chinese and Indian populations increase at currently projected levels, "the two countries alone will need a total of 119 million barrels of oil a day...almost double the world's entire demand today."

Environmental regulation can significantly affect energy choices and costs, and compliance will become more difficult if energy prices remain moderate and fossil fuel demand increases as anticipated. There are a host of potential regulatory actions that could require major additional reductions in energy-related emissions during the next decade, and some are expected to be very expensive if compliance must depend on current technology and approaches.

For example, compliance with ozone ambient air quality standards promulgated in 1997 could cost nearly \$10 billion per year, and will particularly affect cars and powerplants. Also in response to standards promulgated in 1997, controlling small particulates could cost \$40 billion per year, and require further reductions in sulfur emissions from powerplants and reduced refinery emissions. If reductions in mercury at coal powerplants are pursued, the price tag could approach \$6 billion per year.

Electric utility restructuring has brought competition to the wholesale market under existing federal authority, and there is considerable support for bringing competition to retail markets as well. It is not clear what the restructured industry will ultimately look like, but there will be a transition period that could last a decade or more, when the emphasis will be on profit and competitive survival. Industry R&D, particularly during this period, is expected to be minimal and focused on near-term operational issues. Unless there is

“Doing R&D with one eye on the clock and the other on the bank balance cannot enhance the likelihood of making a technological breakthrough. Long-term research in industry isn’t very long-term. Unfortunately, too many executives look at R&D as an expense rather than as an investment. It’s when we lose the longer-term vision of why we are doing something that I get worried, and that’s happening.”

George Heilmeier, President and CEO of Bellcore

legislative relief, there could be a major adverse affect on industry investment in longer-term RD&D for renewables and advanced, lower-emission fossil fuel technologies. An additional anticipated outcome of increased competition is that companies will attempt to maximize the use, for as long as possible, of older, fully-depreciated plants, especially coal plants.

An aging U.S. energy infrastructure raises concerns that tie to environmental issues. Coal accounts for 55% of domestic electricity production. By 2015, 60% of existing coal-fueled electricity generation capacity will be over 40 years old. While it may be profitable in a highly competitive industry to continue to run these plants, it could make it more difficult to achieve national environmental goals relating to ozone and CO₂ reduction. Nuclear energy currently accounts for 22% of domestic electricity production. By 2015, 40% of nuclear capacity will have reached the end of its 40-year license terms, but it is not clear how long these and other plants will operate due to regulatory and economic issues. Continuing to run these plants raises environmental issues, as does replacing them with fossil-fueled plants. As local natural gas distribution systems continue to age, there is concern about methane leaks and the potential impact of this potent greenhouse gas.

Global trade competition and privatization have become major factors in the post-Cold War era as countries increasingly rely on exports in pursuit of prosperity. The energy infrastructure requirements for developing nations will require trillions of dollars over the coming decades, and significant amounts of goods and services will be imported from industrialized countries. In many cases, trade barriers still exist. For example, in some countries trade is impeded by lack of a legal and financial framework. Where governments still exercise decision-making control, industries may need to work through government-to-government contacts. Some countries may be disadvantaged because governments in competing countries provide significant assistance to their industries.

Declining R&D budgets have become a reality throughout the domestic energy industry. Electric utilities, in anticipation of increased competition, have already significantly reduced discretionary funding, including reductions of

R&D by 30% in the past two years. The oil and gas industry has also significantly reduced R&D applicable to domestic prospects, both in response to increased global competition and greater emphasis on overseas opportunities. Deficit-reduction has put increasing pressure on DOE-supported R&D, which has decreased in real terms by about one-third since 1990. Domestic energy R&D budget declines come at a time when environmental and energy security threats are becoming more real, and governments of our main global competitors are continuing to strongly support energy R&D in strategically important technology areas such as renewables, fuel cells and carbon sequestration.

A Growing R&D Gap?

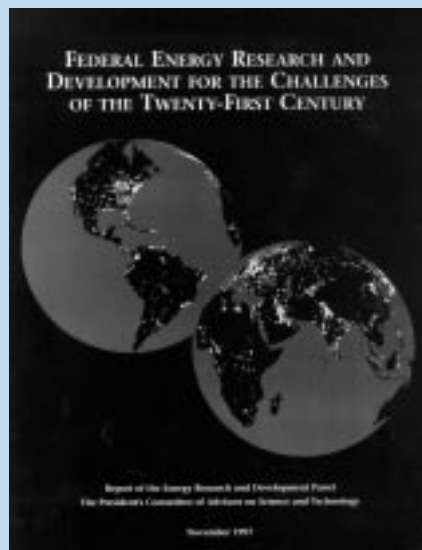
“...while the challenges looming in the energy future of the United States and the world have been growing in recent years – or at least growing more apparent – expenditures on R&D have been declining....

Although data for energy R&D in the U.S. private sector are less comprehensive than those for government R&D, the most recent systematic study of energy industry R&D trends found that the industry’s spending for R&D fell 40 percent in real terms between 1985 and 1994....The R&D spending of the 112 largest U.S. operating electric utilities fell 38 percent between 1993 and 1996 alone, and the R&D of the four U.S. oil firms with the largest research efforts approximately halved between 1990 and 1996....Japan, however, increased its public sector energy R&D spending from about \$1.5 billion in 1974 to \$4.2 billion in 1980; by 1995, the figure was \$4.9 billion, about twice as high as DOE’s energy R&D spending.”

Report of the Energy Research and Development Panel

The President’s Committee of Advisors on Science and Technology

November 5, 1997



Goals, Objectives, Strategies and Success Measures



The Fossil Energy Strategic Plan pursues its mission and vision through three goals, which fall under the broad categories of environment, energy security, and information development and dissemination. These goals and associated objectives are summarized in Table I, and are included below with strategies and success measures.

The Strategic Plan includes a variety of quantifiable success measures to help determine progress toward meeting goals and objectives. These range from intermediate milestones to actual outcomes, depending on the maturity of the program. Detailed measures can be found in the strategic plans for Coal and Power Systems, Oil and Natural Gas, and the Strategic Petroleum Reserve. The success measures, shown below in *italics* under strategies, are illustrative and focus on the near-term consistent with the emphasis of the Government Performance and Results Act (GPRA).

TABLE 1: Fossil Energy Strategic Goals and Objectives

GOALS	OBJECTIVES
<p>GOAL 1 Environment</p> <p>Eliminate environmental issues as a barrier to fossil fuel production and use, while maintaining the availability and affordability of fossil fuels.</p>	<p>Objective 1: By 2010, make available cost-effective power systems with negligible emissions of conventional pollutants and significantly reduced CO₂, that achieve generating efficiencies greater than 60% using coal, 75% using natural gas, and 85% in combined heat and power applications</p> <p>Objective 2: During the 2003-2010 period, make available technologies for existing coal powerplants that will significantly lower the cost of meeting more stringent environmental regulations.</p> <p>Objective 3: During the 2005-2015 period, make available a suite of cost-effective options with increasingly large carbon sequestration capacity.</p> <p>Objective 4: Support R&D policies and improved regulatory practices that can moderate future price increases and fuel 25 percent of the anticipated 6 TCF increase in domestic natural gas production through 2010.</p> <p>Objective 5: Resolve potential environmental issues associated with domestic oil and gas recovery and processing.</p>
<p>GOAL 2 Security</p> <p>Ensure the availability of secure, affordable liquid fuels.</p>	<p>Objective 1: Ensure the readiness of the Strategic Petroleum Reserve to respond to short-term oil supply interruptions and price spikes by drawing down its inventory of crude oil at a sustainable rate of 4.2 million barrels/day within 15 days of direction from the President.</p> <p>Objective 2: Improve the capability of the Nation's petroleum industry to increase the supply of secure, domestic oil by an average of 0.5 million barrels/day during the 2001-2010 period while significantly reducing the environmental impact of oil production.</p> <p>Objective 3: Provide the Nation with large, lower-polluting alternative sources of liquid transportation fuels that are cost-competitive with equivalent petroleum products, for deployment beginning around 2010.</p>
<p>GOAL 3 Information</p> <p>Foster sustainable development and use of energy resources through analytical and information-intensive activities.</p>	<p>Objective 1: Promote the export of U.S. Fossil fuel technology, equipment and services to: create/maintain U.S. Jobs and reduce the trade deficit; reduce local, regional and global environmental impacts, and diversify sources of liquid fuels supplying export markets.</p> <p>Objective 2: Help ensure the reliability of environmentally acceptable energy supplies by managing the regulatory review, as required by law, of certain export/import activities related to natural gas and electricity.</p>

Goal 1

Environment



Eliminate environmental issues as a barrier to fossil fuel production and use, while maintaining the availability and affordability of fossil fuels.

Environmental issues occur throughout the fossil energy fuel cycle. Objectives and strategies for this goal address:

- Compliance of existing, coal-fired powerplants with emerging environmental regulations, and of future gas and coal powerplants with even more stringent future regulations
- Increasing the affordable domestic natural gas resource base to permit greater use of this lower carbon, lower-polluting fuel.
- Environmental compliance for oil and gas recovery and processing

Objective 1

By 2010, make available cost-effective power systems with negligible emissions of conventional pollutants and significantly reduced CO₂, that achieve generating efficiencies greater than 60 percent using coal, 75 percent using natural gas, and 85 percent in combined heat and power applications.

Strategies:

1. Develop a utility-scale, high efficiency, ultra-clean gas turbine that will break through the operating temperature limits of today's technology, and be a key component of future, high efficiency gas and coal-fueled powerplants.
 - *In FY 1999, complete full-scale component testing of two advanced, utility-scale turbines with over 60 percent efficiency when used in combined cycles (new plants are currently about 50 percent) and with ultra-low NO_x emissions. Initiate full speed, no load testing with two gas turbine manufacturers.*

2. Develop advanced fuel cell systems and advanced fuel cell-turbine combined cycles for distributed power applications, and as a key component of future, ultra-high efficiency gas and coal-fueled powerplants.

- *In FY 1999, complete testing of the first commercial-sized fuel cell module (100 KWe) using high temperature solid oxide technology suitable for high-efficiency electricity generation.*

3. Develop advanced coal-fueled systems, including cycles building on experience from the Clean Coal Technology Demonstration program.

- *In FY 1999, begin testing of an advanced pulverized coal powerplant technology that will ultimately achieve efficiencies up to 45% and NO_x and SO_x less than 1/6 NSPS.*
- *In FY 1999, complete commercial demonstration of one integrated gasification combined cycle project which, along with two other projects, will establish the engineering foundation leading to a new generation of 60% efficiency, ultraclean coal plants.*
- *By 2005, develop new coal-based power generation systems that will meet or exceed emissions limits for SO₂, NO_x and particulates with efficiencies over 50% (versus under 35% today).*

Presidential Panel Recommends R&D to Keep Coal Strategic Part of Energy Future

“...the use of low cost coal is a practical necessity in many parts of the world including China and India where inexpensive natural gas is not likely to be found. The technology choice made by these countries will have global as well as regional and local environmental consequences and are, therefore, of importance to the United States. Consequently, the panel endorsed two essential and interacting elements of a coal R&D strategy to be carried out in partnership with the private sector: (1) developing cost-effective technologies that are attractive to coal-intensive developing countries and are much better environmentally with significantly reduced CO₂ emission rates; and (2) inventing and developing advanced components and systems leading to DOE’s *Vision 21* with investigation of CO₂ sequestration schemes and approaches to lower-cost clean transportation fuels including hydrogen manufacture and distribution for transportation and electric power. If successful, this R&D could lead to coal’s retaining a strategic part of the U.S. energy future.”

Report by the President’s Committee of Advisors for Science and Technology, November 5, 1997

4. Develop advanced fossil power and liquefaction technology modules to configure a “*Vision 21 Energyplex*” fleet of plants with carbon sequestration options that can deliver a competitive mix of electricity, fuels, and/or chemicals with near-zero environmental emissions.

- *[FY 1999 measures for other strategies relevant to coal gasification, fuel cells, advanced turbines and coal liquefaction all support the Vision 21 concept]. By 2004, complete development of advanced membrane separation technology to provide low-cost oxygen to the gasification module for Vision 21 plants (for availability in 2010)*

Objective 2

During the 2003-2010 period, make available technologies for existing coal powerplants that will significantly lower the cost of meeting more stringent environmental regulations.

The Potential for Sequestration

Controlling carbon emissions in a fossil fuel dependent world will be difficult, especially with rapidly growing energy demand in developing countries. Carbon sequestration is receiving attention as a potential approach, along with energy efficiency and use of lower/no carbon fuels, for dealing with this challenge. Annual worldwide manmade carbon emissions are about 6.4 billion tons, with the U.S. accounting for nearly one--fourth. While these emissions are large, the earth's ability to store additional carbon is also large. For example, depleted oil and gas reservoirs in the U.S. could hold up to 1.8 trillion additional tons of carbon, saline aquifers up to 10 trillion tons, and forests and other plants on land about one trillion tons. The greatest potential is in the oceans, which contain up to 100 trillion tons of carbon. Projects are underway already to reduce carbon by planting and protecting trees, and by injecting CO₂ into aquifers. Researchers are looking at a variety of innovative approaches, such as making small improvements in the amount of plants growing in the ocean which could lead to sequestration of large quantities of carbon in ocean sediment, and also provide new sources of food for a growing population. While there are many novel concepts, further research is needed to determine the potential for such measures to reduce atmospheric carbon dioxide levels, to lower costs, and to ensure that these techniques do not introduce new environmental risks.

Strategies

1. Develop applied science and new technologies for addressing emissions of hazardous pollutants
 - *In FY 1999, initiate a science-based program to achieve cost-effective control of mercury emissions.*
2. Develop, in the near-term, low-cost technologies to significantly reduce NO_x, SO₂ and particulate emissions to address reduction of ozone and increased control of fine particulates
 - *In FY 1999, initiate a program to develop more accurate monitoring capabilities and identify cost-effective mitigation strategies for fine particulates (e.g., PM 2.5)*
3. Develop the applied science and new technologies for waste minimization, including solid and liquid wastes
 - *In FY 1999, establish a government/industry partnership to pursue the goal of substantially increasing recycling reuse and waste minimization of the byproducts of coal use.*

Objective 3

During the 2005-2015 period, make available cost-effective options with increasingly large carbon sequestration capacity.

1. Develop the applied science and new technologies for addressing the cost-effective management/sequestration of carbon emissions from the production and use of fossil fuels.

- *In FY 1999, initiate an exploratory research program on cost-effective novel concepts for capturing, reusing or storing, or otherwise mitigating carbon emissions.*

Objective 4

Support R&D policies and improved regulatory practices that can moderate future price increases and fuel 25 percent of the anticipated 6 TCF increase in domestic natural gas production through 2010.

Strategies:

1. Develop tools and methodologies for recovering natural gas from known reservoirs.

- *In FY 1999, transfer secondary gas recovery technologies to industry, contributing 180 Bcf of reserve growth potential in mature south Texas reservoirs.*

2. Develop advanced drilling, completion and stimulation technology to reduce costs, minimize formation damage and improve the producibility of wells.

- *In FY 1999, complete demonstration of an advanced drilling and completion technology system that, along with other systems under development, could ultimately contribute to an additional 6 TCF of domestic gas reserves.*

3. Develop technologies to locate and produce gas from methane hydrates.

- *In FY 1999, complete a preliminary version of gas hydrates seismic model based on field and laboratory data.*

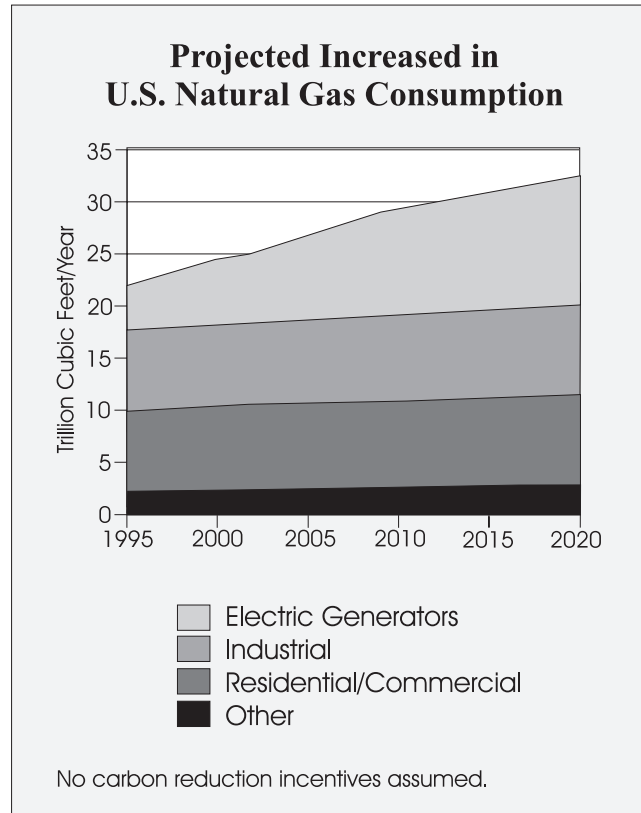


Figure 3

4. Assure effective technology transfer and leveraging of funds through cost-sharing with industry, cooperation with the Gas Research Institute and Petroleum Technology Transfer Council, and working with industry RD&D groups such as the Natural Gas & Oil Technology Partnership

- *In FY 1999, as part of the Natural Gas & Oil Technology Partnership, develop a new method for exploration of geopressured hydrocarbon reservoirs based on modeling of the development of pressure seals.*

5. Develop technologies and practices that increase production by decreasing the cost of effective environmental protection and compliance associated with gas recovery.

- *In FY 1999, towards an overall program objective to reduce cumulative industry compliance costs by \$16 billion by 2010,*
 - complete an online environmental compliance expert system with states that will improve oil and gas production economics by reducing time and costs for permitting and reporting, and
 - complete three clearly written/”plain English” manuals that facilitate oil and gas industry compliance with state and Federal exploration and production environmental regulations.

6. Develop cost-effective technologies for upgrading to pipeline quality the over 30 percent of domestic natural gas production that does not meet pipeline standards.

- *In FY 1999, complete development and demonstration of technology that will improve nitrogen removal from natural gas.*

7. Assist the storage industry to increase deliverability and capacity and to develop more accurate and timely gas measurement

- *In FY 1999, demonstrate the first design concept for alternative storage technologies.*

Objective 5

Resolve potential environmental issues associated with domestic oil and gas recovery and processing.

Strategies:

1. Reduce potential environmental impacts of oil and gas recovery through advances in drilling, imaging, and computational technologies that reduce the recovery “footprint,” and overall number of wells.

- *[See FY 1999 measures under Goal 1/Objective 4 /Strategy 2 and Goal 2/Objective 2/Strategy 2.]*

2. Develop technologies to reduce the escape of natural gas into the atmosphere

- *In FY 1999, demonstrate a mobile methane leak visualization detection system with a range of at least 100 meters.*

3. Develop new compliance technologies and approaches, such as disposal of produced waters and nonhazardous oil field waste, that lower environmental costs without increasing risks.

- *In FY 1999, demonstrate commercial-scale economic process for treatment and onsite subsurface disposal of naturally occurring radioactive materials from oil and gas operations.*

4. Develop credible scientific information to serve as the basis of risk-based regulation and compliance.

- *In FY 1998, implement risk-based data management systems for improved regulatory decision making in 10 States.*
- *In FY 1999, initiate activities with industry, states and EPA to conduct research to help EPA make decisions based on sound science regarding particulate matter emissions from oil processing.*

Goal 2

Energy Security



Ensure the availability of secure, affordable liquid fuels.

This goal covers activities directed at both short- and longer-term liquid fuels supply issues, which are driven primarily by transportation needs, and includes:

- Maintaining the Strategic Petroleum Reserve as the primary means of reducing U.S. vulnerability to the consequences of short-duration oil supply shortfalls
- Increasing economically recoverable domestic oil supplies to reduce future import dependence
- Converting natural gas and coal to liquids to provide longer-term options for augmenting domestic and worldwide liquid fuel supplies

Some strategies under Goal 1 also have relevance to Goal 2. For example, natural gas and electricity could become important transportation fuels if appropriate technology emerges.

Objective 1

Ensure the readiness of the Strategic Petroleum Reserve to respond to short-term oil supply interruptions and price spikes by drawing down its crude oil inventory at a sustainable rate of 4.2 million barrels/day within 15 days of Presidential direction.

Strategies

1. Degasify crude oil currently unusable because of its high vapor pressure.
 - *In FY 1998, complete the oil degasification effort by degasifying approximately 11 million barrels, bringing the total to 169 million degassed barrels. This will make all of the SPR oil available for drawdown and increase 90-day drawdown capability from 3.7 to approximately 4.0 million barrels per day.*

2. Replace and/or upgrade drawdown-critical systems so that they have a life expectancy of 25 years.

- *In FY 1999, initiate an additional 4 percent of the infrastructure Life Extension Program, thereby bringing program implementation to approximately 97 percent of the \$320 million program. Program completion in FY 2000 will increase sustained drawdown capability to 4.2 million barrels per day (versus 3.7 in FY 1997) at the current fill level of 563 million barrels.*

3. Ensure system readiness to distribute crude oil.

- *In FY 1999, perform an annual assessment of commercial systems' capability to distribute SPR crude into the marketplace, and develop remedial plans, as appropriate, to maintain adequate SPR connectivity to commercial systems (defined as 120% of drawdown rate capability).*

Objective 2

Improve the capability of the U.S. petroleum industry to increase the supply of secure, domestic oil by an average of 0.5 million barrels/day in the 2001-2010 period while significantly reducing the environmental impact of oil production.

Strategies:

1. Develop enhanced recovery tools and methodologies for recovering oil from known reservoirs.

- *In FY 1999, complete demonstrations of four advanced production enhancement technologies for Slope and Basin Clastic Reservoirs, adding 30 million barrels of reserves, and ultimately adding 160 million barrels of new reserves from expansion of the technologies throughout the four target areas.*

2. Develop advanced remote imaging, instrumentation and computational technology needed to find undiscovered oil in deeper and higher temperature reservoirs.

- *In FY 1999, increase resolution of cross-well tomographic imaging to 5 feet or less, and complete development of technologies for single well seismic imaging that can aid industry in finding an additional 4 billion barrels of oil.*

3. Develop technologies and practices that increase production by decreasing the cost of effective environmental protection and compliance associated with oil recovery.

- *[See FY 1999 measures for natural gas under Goal 1, Objective 4, Strategy 5.]*

4. Assure effective technology transfer through cost-sharing with industry, and working with groups such as the Natural Gas & Oil Technology Partnership and the Petroleum Technology Transfer Council.

- *In FY 1999, transfer results of Reservoir Class projects aiding industry to increase domestic oil recovery by about 500 million barrels by 2000.*

Objective 3

Provide the Nation with lower-polluting alternatives to liquid transportation fuels that are cost-competitive with equivalent petroleum products for deployment beginning around 2010.

Strategies

1. Develop processes for early (pre-2010) market entry that produce premium liquid fuels by co-processing coal with resid, used oil, waste plastics, tires, and other solid wastes, and integrating with existing refineries.

- *In FY 1999, initiate catalyst/reactor performance testing for producing premium, ultra-low emission diesel feedstocks from solid carbonaceous feedstocks.*

2. Develop, for longer-term deployment, coal liquefaction processes based on two-stage direct and Fischer-Tropsch Slurry-Phase indirect liquefaction.

- *[Measure for previous strategy also supports this]*

3. Develop breakthrough gas-to-liquids technology to convert unmarketable Alaskan and other remote natural gas to high quality, cleaner transportation fuels and premium chemicals.

- *In FY 1999, complete development of fabrication techniques for ceramic membrane/catalyst elements for advanced gas-to-liquids conversion.*

Goal 3

Information



Foster the sustainable development and use of energy resources in the U.S. and elsewhere through analytical and information-intensive activities that support or complement Fossil Energy R&D.

This goal encompasses a variety of activities that require the development of fossil energy-related data and analysis, including:

- Educating/influencing other parts of Government on energy-related issues, policies, legislation and regulations.
- Promoting export of energy technologies and services by providing technical assistance and information to U.S. industry and foreign and domestic governmental agencies.
- Managing the regulatory review of certain import/export activities by analyzing the impacts on U.S. markets of cross-border natural gas trade and impacts of electricity exports on domestic electricity system reliability.

Objective 1

Promote the export of U.S. fossil fuel technology, equipment and services to: create/maintain U.S. jobs and reduce the trade deficit; reduce local, regional and global environmental impacts, and; diversify sources of liquid fuels supplying export markets.

Strategies:

1. Discover, and convey to U.S. industry, information on new international energy investment opportunities

- *In FY 1999, identify \$500 million in new powerplant opportunities.*

2. Help U.S. energy companies to form alliances with foreign counterparts to facilitate U.S. exports

- *In FY 1999, assist U.S. companies to form alliances for five energy technology projects in Eastern Europe.*

3. Provide technical assistance to foreign governments to develop international standards that support U.S. policies and energy industry needs.

- *In FY 1999, complete study with Mexico's Commission de Integracion Electrica Regional that includes development of technical standards and regulatory policies to facilitate development of cross border pooling arrangements.*

4. Work with multilateral banking and investment communities to promote an effective trade finance strategy for U.S. energy projects

- *In FY 1998, work with the Trade Promotion Coordination Committee to complete a report to Congress on an interagency trade finance strategy for energy projects in Asia and Latin America.*

5. Implement cooperative agreements for research and technology exchange where beneficial to U.S. interests

Objective 2

Help ensure the reliability of environmentally acceptable energy by managing the legally required regulatory review of certain export/import activities related to natural gas and electricity

Strategies:

1. Maintain a regulatory program that promotes market sensitive natural gas and electricity trade, with minimal government intervention.

- *In FY 1999, create an advanced Internet based information distribution system that will replace the current electronic bulletin board, to increase customer access contacts per month by 200.*

2. Authorize construction of international transmission lines

3. Authorize imports/exports of natural gas and electricity

- *In FY 1999, revise regulations governing the natural gas import/export and electricity export process, to reduce customer burden by 10%.*

4. Implement provisions of the Powerplant and Fuel Use Act
5. Coordinate energy regulatory activities with international trading partners

Crosscutting Strategies

Several areas are highlighted below that support and crosscut most Fossil Energy programs, including all oil, gas and coal R&D programs.

1. Engage in frequent and meaningful dialogue to allow stakeholders to:
 - Provide input concerning needs and priorities
 - Identify effective customer-driven, public-private partnerships
 - Better utilize results of DOE-supported work.
2. Continue commitment to environment, safety and health activities by:
 - Moving beyond regulatory compliance, where necessary, to ensure adequate protection to workers, the public and the environment
 - Establishing annual site-specific goals to strive towards zero injuries, occupational illnesses, and safety and environmental incidents
 - Taking steps to minimize waste, but where generated, ensure that it is handled and disposed of properly.
3. Carry out advanced research, as a bridge between basic and applied research, to identify breakthrough technologies for further development or new applications of existing technologies.